



*Design Manual Supplement*

Effective Date: 3/25/2004

## **Design Speed**

### **I. Introduction**

#### **A. Purpose**

To revise Washington State Department of Transportation (WSDOT) policies to:  
1) remove the implication of the need for an operating speed study for preservation & improvement projects on existing alignments. 2) treat modified and full design levels similarly with respect to design speed. 3) minimize reference to posted speed to all extent possible when discussing design speed. 4) clarify how design speed is considered on WSDOT projects and align the process with the Urban Roadways *Design Manual Supplement* guidance.

#### **B. References**

*Design Manual*, M 22-01, WSDOT

*Design Manual Supplement*, Urban Roadways, dated July 22, 2003

*Manual on Uniform Traffic Control Devices for Streets and Highways*, USDOT, FHWA; including the Washington State Modifications to the *MUTCD*, M 24-01, WSDOT (*MUTCD*), <http://www.wsdot.wa.gov/biz/trafficoperations/mutcd.htm>.

#### **C. Background**

Before 1996 using the posted speed as the design speed on modified design level projects often resulted in a design speed less than the operating speed. The maximum posted speed on non-Interstate roadways was set, by law, at 55 mph regardless of the operating speed. On many rural highways, the operating speed was higher than the posted speed. On these highways, selecting the posted speed as the design speed resulted in the operating speed higher than the design speed. Safety concerns with this led to design guidance requiring the operating speed to be considered when establishing the design speed.

Since 1996 this problem was reduced. The State law governing posted speed on highways was revised allowing the posted speeds to be increased to a maximum of 70 mph. It states "...in accordance with the design speed thereof (taking into account all safety elements included therein), or whenever the secretary determines upon the basis of an engineering

and traffic investigation that such greater speed is reasonable and safe under the circumstances existing on such part of the highway.”<sup>1</sup>

The continued consideration of the operating speed is causing more work than is appropriate on some modified design level projects. Speed studies often result in increasing the posted speed. The higher posted speed raises the design speed, requiring work that may not be appropriate.

#### **D. Discussion**

The design speed is used to determine the various geometric design features of the roadway. Sight distance, superelevation, acceleration and deceleration lane length, and maximum grade are the main design elements that depend on the design speed. A uniform design speed throughout a corridor provides greater consistency in the roadway elements, which is consistent with driver’s expectations.

The existing *Design Manual* guidance for design speed on modified design level projects recommends designers consider operating speed, which usually results in a speed study. When the speed study indicates that a higher posted speed is justified, and the speed limit is increased, additional expense and effort is required to bring the design elements in line with the new design speed. Removing the modified design level requirement to establish a design speed no lower than the operating speed, will reduce expense and provide more uniformity in meeting driver’s expectations.

To encourage a more uniform application of design speed for all projects, the relationship between the posted speed and the design speed for full design level, Chapter 440, is used for the desirable design speed on modified design level projects. Also, this relationship is adjusted to more reasonable values.

Some projects retain geometric design elements that are designed for a speed that is lower than the posted speed. Investigate the need, per the MUTCD, to install warning signs in advance of the deficiency, to maintain safety. Warning signs must be in accordance with the MUTCD to insure that the traveling public will understand the sign. Some signs, such as limited sight distance signs, have been found to have no effect in slowing vehicles and are not well understood by drivers<sup>2</sup>. The preferred option with deficient sight distance at a vertical curve is to sign any secondary hazard that is hidden by the sight distance deficiency.

Geometric design data figures for Interstate and principal arterial are changed to agree with the relationship between the posted speed and the design speed and to correct some concerns with the figures presented in the Urban Roadways *Design Manual* Supplement.

#### **E. Implementation**

This change is effective on the date of this supplement and will expire when the changes are incorporated in the *Design Manual*.

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<sup>1</sup> RCW 46.61.410, Increases by secretary of transportation -- Maximum speed limit for trucks -- Auto stages -- Signs and notices.

<sup>2</sup> See John C. Glennon, “Effects of Sight Distance on Highway Safety”, State of the Art Report 6, TRB 1987

## II. Instructions

### A. Replace 430.02, Design Speed, with the following:

When applying modified design level to a project, select a design speed for use in the design process that reflects the character of the terrain and the type of highway. The desirable design speed for modified design level is given in Figure 430-A. The minimum design speed is not less than the posted speed, or the proposed posted speed. (See Chapter 440 for additional information on design speed.) Document which speed was used, include any supporting studies and data.

Route Type	Posted Speed	Desirable Design Speed
Freeways	All	10 mph over the posted speed
non-Freeways	45 mph or less	Not less than the posted speed
	Over 45 mph	5 mph over posted speed

**Desirable Design Speed**  
**Figure 430-A**

When the posted speed exceeds the design speed for existing geometric features that are to remain in place (curve radius, superelevation, sight distance, or other elements that the design speed controls) one of two choices must be made:

1. Work with the region Traffic Office to lower the posted speed to be consistent with the existing design speeds for the geometric features on the facility, which would entail the removal and replacement of the existing speed limit signs.
2. A corridor analysis can be completed in order to leave the posted speed unchanged and identify all design elements that do not meet the criteria for the existing posted speed. Identify each appropriate location for cautionary signing (including road approach sight distance) and work with the region Traffic Office to install the cautionary signing as provided for in the MUTCD (either by contract or region sign personnel). Consult with and obtain guidance from Region Project Development leadership prior to progressing with the corridor analysis and the design. An approved deviation is required for any design element that does not meet the design speed.

### B. Replace Figures 430-3 and 430-4 with the attached (pages 5 & 6)

### C. Add the following to 440.03, Definitions

<p><b>freeway</b> A divided highway that has a minimum of two lanes in each direction, for the exclusive use of traffic, and with full control of access.</p>
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**D. Replace Figure 440-1 with the following:**

<b>Route Type</b>	<b>Posted speed</b>	<b>Desirable Design Speed</b>
Freeways	All	10 mph over the posted speed
non-Freeways	45 mph or less	Not less than the posted speed.
	Over 45 mph	5 mph over the posted speed

**Desirable Design Speed**  
*Figure 440-1*

	Multilane Divided				Multilane Undivided			
	Trucks Under 10%		Trucks 10% and Over		Trucks Under 10%		Trucks 10% and Over	
Design Class	MDL-1	MDL-2	MDL-3	MDL-4	MDL-5	MDL-6	MDL-7	MDL-8
Current ADT (1)	Under 4000	Over 4000	Under 4000	Over 4000	Under 4000	Over 4000	Under 4000	Over 4000
Design Speed	<u>See Figure 430-A</u>							
Traffic Lanes Number Width	4 or more 11 ft	4 or more 11 ft	4 or more 11 ft	4 or more 12 ft	4 or more 11 ft	4 or more 11 ft	4 or more 11 ft	4 or more 12 ft
Parking Lanes Urban	None	None	None	None	8 ft	8 ft (2)	8 ft	8 ft (2)
Median Width Rural Urban	Existing Existing	Existing Existing	Existing Existing	Existing Existing	2 ft 2 ft	4 ft 2 ft	4 ft 2 ft	4 ft 2 ft
Shoulder Width Right (3) Left (4)	4 ft 2 ft	6 ft 2 ft	4 ft 2 ft	6 ft 2 ft	4 ft	6 ft (5)	4 ft	6 ft (5)
Minimum Width for Bridges to Remain in Place (6) (7) (8)	24 ft (9)	26 ft (9)	24 ft (9)	26 ft (10)	48 ft (9)	50 ft (9) (11)	50 ft (9) (11)	54 ft (10) (11)
Minimum Width for Rehabilitation of Bridges to Remain in Place (6) (8) (12)	28 ft (9)	30 ft (9)	28 ft (9)	32 ft (10)	54 ft (9)	60 ft (9) (11) (13)	56 ft (9) (11)	64 ft (10) (11) (13)
Minimum Width for Replacement	Full Design Level Applies (14)							
Access Control	See Chapters 1430 and 1435 and the Master Plan for Limited Access Highways, or WAC 468-52 and the region's Highway Access Management Classification Report							

**Notes:**

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| <p>(1) If current ADT is approaching a borderline condition, consider designing for the higher classification.</p> <p>(2) Parking restricted when ADT is over 15,000.</p> <p>(3) When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft. <u>In urban areas, see Chapter 440.</u> On designated bicycle routes the minimum shoulder width is 4 ft (See Chapter 1020).</p> <p>(4) For lanes 11 ft or more in width, the minimum shoulder width to the face of the curb is 1 ft on the left.</p> <p>(5) May be reduced by 2 ft under urban conditions.</p> <p>(6) Width is the clear distance between curbs or rails, whichever is less.</p> | <p>(7) Use these widths when a bridge within the project limits requires deck treatment or thrie beam retrofit only.</p> <p>(8) For median widths 25 ft or less, see Chapter 1120.</p> <p>(9) Add 11 ft for each additional lane.</p> <p>(10) Add 12 ft for each additional lane.</p> <p>(11) Includes a 4 ft median, which may be reduced by 2 ft under urban conditions.</p> <p>(12) Use these widths when a bridge within the project limits requires any work beyond the treatment of the deck such as bridge rail replacement, deck replacement, or widening.</p> <p>(13) Includes 6 ft shoulders — may be reduced by 2 ft on each side under urban conditions.</p> <p>(14) Modified design level lane and shoulder widths may be used when justified with a corridor or project analysis.</p> |
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**Modified Design Level for Multilane Highways and Bridges**  
**Figure 430-3**

	Two-Lane Highways					
	Trucks Under 10%			Trucks 10% and Over		
Design Class	MDL-9	MDL-10	MDL-11	MDL-12	MDL-13	MDL-14
Current ADT (1)	Under 1000	1000-4000	Over 4000	Under 1000	1000-4000	Over 4000
Design Speed	See Figure 430-A					
Traffic Lane Width (2)	11 ft	11 ft	11 ft	11 ft	11 ft	12 ft
Parking Lanes Urban	8 ft	8 ft	8 ft (3)	8 ft	8 ft	8 ft (3)
Shoulder Width (4)	2 ft	3 ft (5)	4 ft	2 ft	3 ft (5)	4 ft
Minimum Width for Bridges to Remain in Place (6)(7)	22 ft (8)	24 ft	28 ft	22 ft (8)	24 ft	28 ft
Minimum Width for Rehabilitation of Bridges to Remain in Place (7)(9)	28 ft (10)	32 ft	32 ft	28 ft (10)	32 ft	32 ft
Minimum Width for Replacement	Full Design Level Applies (11)					
Access Control	See Chapters 1430 and 1435 and the Master Plan for Limited Access Highways, or WAC 468-52 and the region's Highway Management Classification Report.					

Notes:

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| <p>(1) If current ADT is approaching a borderline condition, consider designing for the higher classification.</p> <p>(2) See Figures 430-5 and 430-6 for turning roadways.</p> <p>(3) Parking restriction recommended when ADT exceeds 7,500.</p> <p>(4) When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft. <u>In urban areas, see Chapter 440.</u> On designated bicycle routes the minimum shoulder width is 4 ft (See Chapter 1020).</p> <p>(5) For design speeds of 50 mph or less on roads of 2,000 ADT or less, width may be reduced by 1 ft, with justification.</p> | <p>(6) Use these widths when a bridge within the project limits requires deck treatment or thrie beam retrofit only.</p> <p>(7) Width is the clear distance between curbs or rails, whichever is less.</p> <p>(8) 20 ft when ADT 250 or less.</p> <p>(9) Use these widths when a bridge within the project limits requires any work beyond the treatment of the deck such as bridge rail replacement, deck replacement, or widening.</p> <p>(10) 26 when ADT 250 or less.</p> <p>(11) Modified design level lane and shoulder widths may be used when justified with a corridor or project analysis.</p> |
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**Modified Design Level for Two-Lane Highways and Bridges**  
**Figure 430-4**